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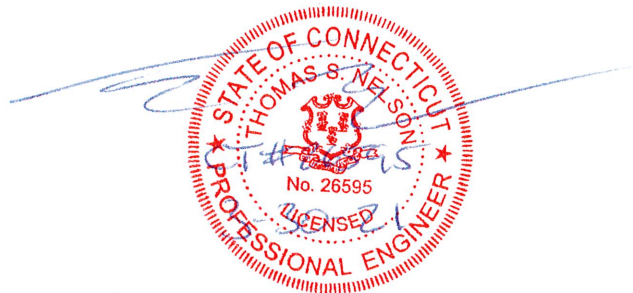
## STORMWATER MANAGEMENT REPORT

Prepared For

PROPOSED SITE DEVELOPMENT

19 HOLLY LANE, DARIEN, CT

March 30, 2021



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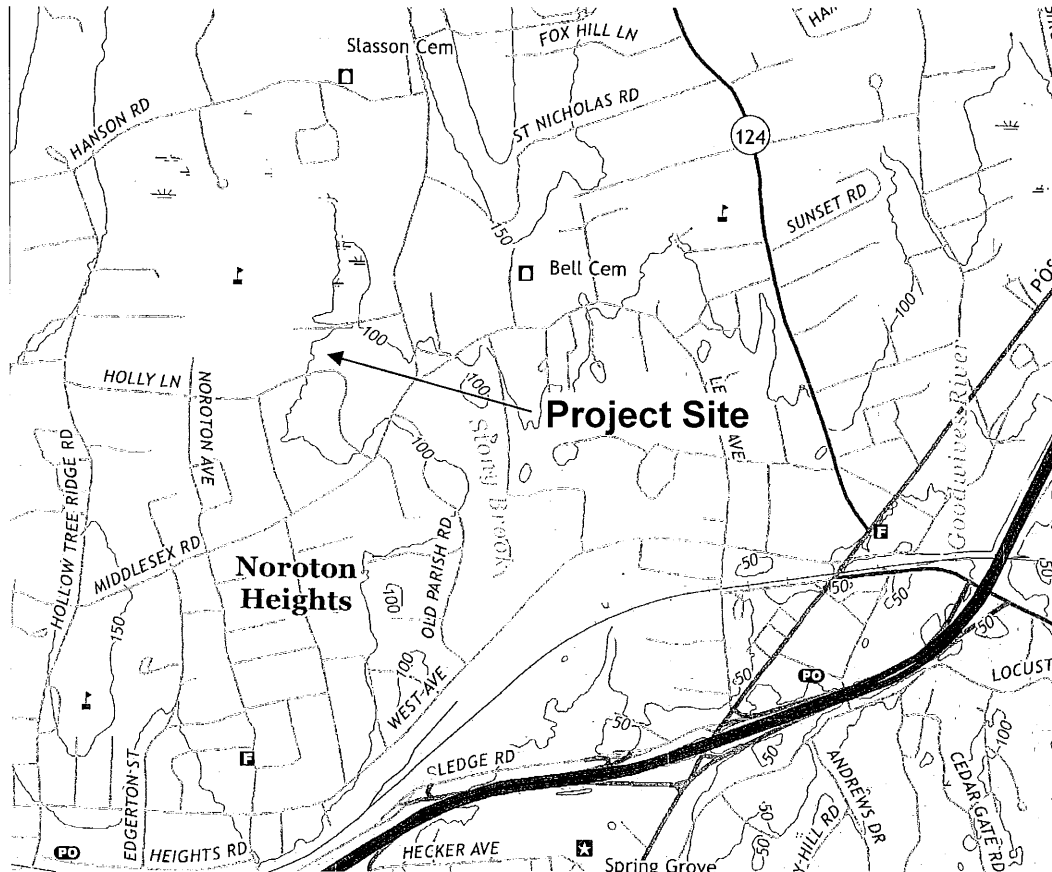
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## 1. INTRODUCTION

McChord Engineering Associates, Inc. has been commissioned by Dan and Jen Anderson to perform stormwater management computations for the proposed site development at 19 Holly Lane in Darien, Connecticut. The property consists of approximately 1.12-acres and is located on the north side of Holly Lane. It is in the Darien River watershed basin and outside of any public water supply watersheds. Figure 1 shows the location of the property on the United States Geological Survey (USGS) map.



**Figure 1: Location Map**

The property is currently developed with a single family residence, asphalt driveway, hardscape and lawn. The edges of the property are Holly Lane and adjacent residences. Topography on the site generally consists of gradual slopes that drain north towards inland wetlands on site. There is a stormwater detention system to control runoff from the existing development. The property is currently served by municipal sewer and water services.

The proposed site development includes construction of a new pool and patio in an area that currently exists as lawn. The existing stormwater management system will be expanded to control runoff from the proposed development. A shallow grass swale will be installed to convey driveway runoff to a planted area prior to the inland wetlands to improve water quality. Soil and erosion controls will be employed to protect downgradient properties and the inland wetlands during construction.

## **2. SCOPE OF STUDY**

This stormwater management report contains studies comparing peak rate of runoff between the existing conditions and the proposed development to ensure that the proposed development will have no adverse impact on adjoining property owners or downstream drainage systems. The site will be developed with its own on-site stormwater management system capable of controlling the increase in peak runoff.

## **3. ANALYSIS METHODOLOGY**

Runoff was modeled with HydroCAD 8.50 software produced by HydroCAD Software Solutions LLC. This software uses the NRCS TR-20 method for analyzing stormwater runoff. Soil characteristics, cover conditions, slope, time of concentration, and historical rainfall data are all parameters that are utilized by this method. The analysis considered the 2, 10, 25 and 50-year storm events. Precipitation depth for each storm event was taken from the National Oceanic and Atmospheric Administration's (NOAA) Atlas 14 Point Precipitation Frequency Estimates specific to the subject property.

## **4. STORMWATER MANAGEMENT STRATEGY**

The drainage area analyzed consists of the portion of property that drains towards the inland wetlands in the rear yard. The front of the property drains towards Holly Lane and will remain undisturbed. Currently, the stormwater runoff in the drainage area is controlled by an existing detention system in the rear yard. Rooftop runoff from the residence is conveyed to the detention system. Runoff from the remainder of the drainage area is not captured and sheet flows overland north towards the inland wetlands.

The existing stormwater management system in the rear yard of the property will be expanded to control the increase in runoff from the proposed development. Rooftop runoff from the existing residence will continue to be routed to the detention system. Runoff from portions of the proposed pool, hardscape and existing hardscape will be captured by strip drains and conveyed to the detention system. The existing detention system consists of twenty-four (24) units of 18" high x 48" wide x 96" long precast concrete galleries surrounded by crushed stone with a storage capacity of approximately 1,367 cubic feet. The proposed expanded detention system consists of twenty-eight (28) units of 18" high x 48" wide x 96" long precast concrete galleries surrounded by crushed stone with a storage capacity of approximately 1,588 cubic feet. Due to the close proximity to wetland soils the system does not rely on infiltration into the underlying soils to function. The existing outlet structure will be relocated to facilitate the expanded detention system. It consists of a yard drain with a 2" diameter low flow orifice that serves as the primary outlet for the detention system. The orifice opens to a 6" PVC pipe that discharges to the inland wetlands just past the limit of lawn. A high level overflow to the 6" PVC is also provided. Runoff from the remainder of the drainage area will continue to flow overland to the inland wetlands conforming to existing conditions.

Detailed information on the size and configuration of the proposed stormwater management measures is available on the most recent revision of the "Site Development Plan" prepared by this office. A Stormwater Facilities Maintenance Plan is also included in Appendix B.

## 5. ANALYSIS & RESULTS

Runoff from the drainage area was analyzed under existing and proposed conditions. The existing conditions analysis modeled the entire drainage area as a whole. The proposed conditions analysis divided the drainage area into area that is detained through the proposed detention systems and undetained areas. The proposed runoff that is not detained will sheet flow to the inland wetlands, conforming to existing conditions.

Using the NRCS TR-20 method, the peak rate of runoff for the 2, 10, 25 and 50-year storm events was computed for the site. Soils on the property were determined using the NRCS Web Soil Survey. Cover conditions were derived from site observations and the "Site Development Plan" prepared by this office, dated March 30, 2021. Soil testing was performed when the stormwater management system was first proposed. The testing showed that the soils on site have a high groundwater table. Therefore, infiltration is not utilized in the analysis of the stormwater management system. The resulting peak flow rates under both the existing and proposed conditions are summarized in Table 1. For detailed computations see Appendix A.

**Table 1: Peak Flows**

<b>Storm Event</b>	<b>Existing Rate (cfs)</b>	<b>Proposed Rate (cfs)</b>
<b>2-year</b>	0.78	0.75
<b>10-year</b>	1.57	1.50
<b>25-year</b>	2.09	2.05
<b>50-year</b>	2.48	2.47

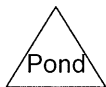
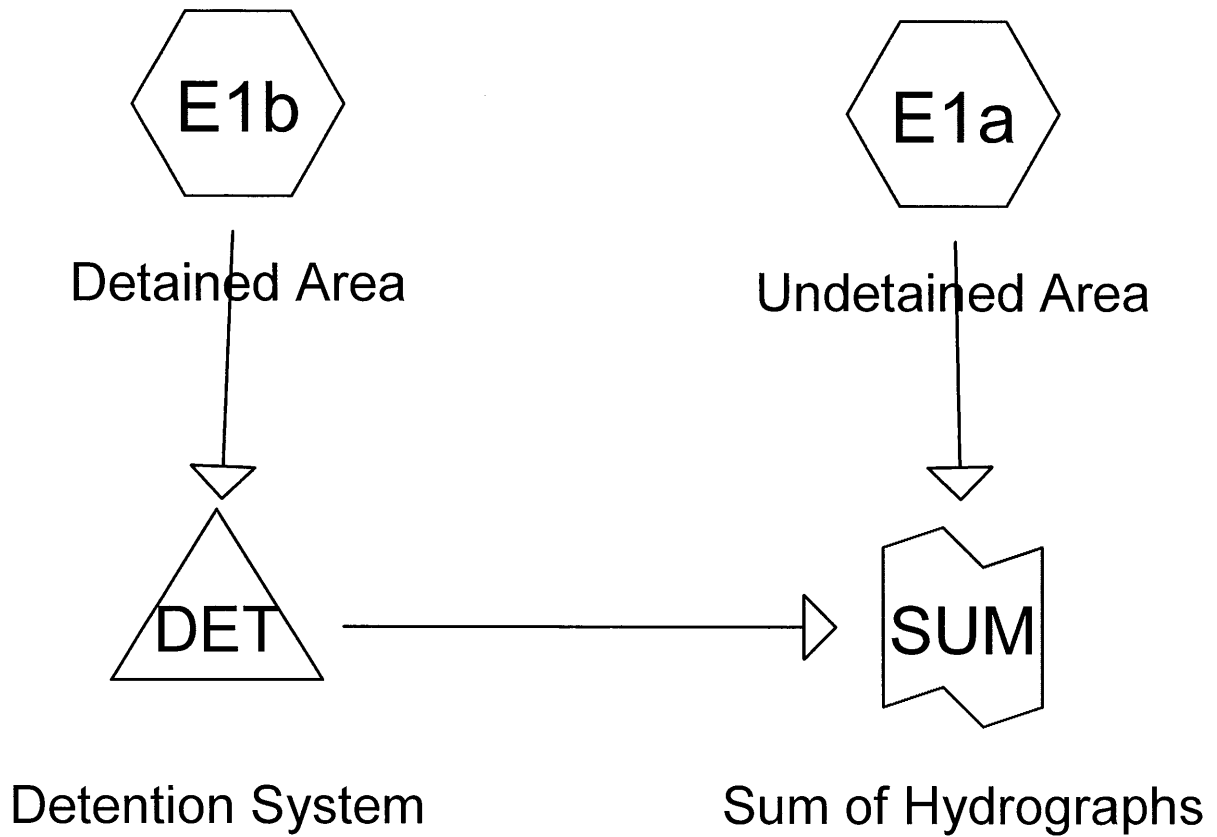
The analysis shows that there is no increase in the peak rate of runoff from the property during any of the analyzed storm events. Since there is no infiltration capacity in the soils on site, other measures were taken to improve the stormwater quality. The pool and hardscape that is not captured will sheet flow through an array of plantings before reaching the inland wetlands. Driveway runoff will now be conveyed through a grass lined swale to another planted area before reaching the wetlands. Both of these measures will provide filtration of stormwater runoff and improve the water quality being discharged to the inland wetlands.

A drainage review was also conducted of adjacent properties to determine if the proposed development would affect any downstream confluence points. A visual inspection was made and available GIS mapping was reviewed. There is no apparent confluence point in close proximity to the proposed development. No erosion or drainage issues immediately downstream of the proposed development were evident at the time of our review.

## 6. CONCLUSIONS

Based on our analysis, McChord Engineering Associates, Inc. has demonstrated that the proposed stormwater management system will adequately control the increase in runoff from the proposed development at 19 Holly Lane in Darien, Connecticut. It is the opinion of this office and the conclusion of this report that the proposed site development will have no adverse impacts to the adjoining property owners, the inland wetlands or any downstream drainage systems.

**APPENDIX A:**  
**PEAK FLOW COMPUTATIONS**



## Existing Conditions - 19 Holly

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### Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
6,630	70	Woods, Good, HSG C (E1a)
10,270	74	>75% Grass cover, Good, HSG C (E1a)
16,770	77	Woods, Good, HSG D (E1a)
1,795	98	Driveway (E1a)
1,045	98	Rear Hardscape (E1a)
3,480	98	Residence (E1b)
<b>39,990</b>		<b>TOTAL AREA</b>



**Existing Conditions - 19 Holly***Type III 24-hr 50-yr Rainfall=7.46"*

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Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 points

Runoff by SCS TR-20 method, UH=SCS

Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment E1a: Undetained Area**

Runoff Area=36,510 sf 7.78% Impervious Runoff Depth=4.78"

Flow Length=150' Slope=0.0100 '/' Tc=37.7 min CN=77 Runoff=2.38 cfs 14,548 cf

**Subcatchment E1b: Detained Area**

Runoff Area=3,480 sf 100.00% Impervious Runoff Depth=7.22"

Tc=5.0 min CN=98 Runoff=0.61 cfs 2,094 cf

**Pond DET: Detention System**

Peak Elev=98.36' Storage=1,091 cf Inflow=0.61 cfs 2,094 cf

Outflow=0.10 cfs 1,762 cf

**Link SUM: Sum of Hydrographs**

Inflow=2.48 cfs 16,309 cf

Primary=2.48 cfs 16,309 cf

**Total Runoff Area = 39,990 sf Runoff Volume = 16,641 cf Average Runoff Depth = 4.99"****84.20% Pervious = 33,670 sf 15.80% Impervious = 6,320 sf**

**Existing Conditions - 19 Holly**

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Type III 24-hr 50-yr Rainfall=7.46"

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**Summary for Subcatchment E1a: Undetained Area**

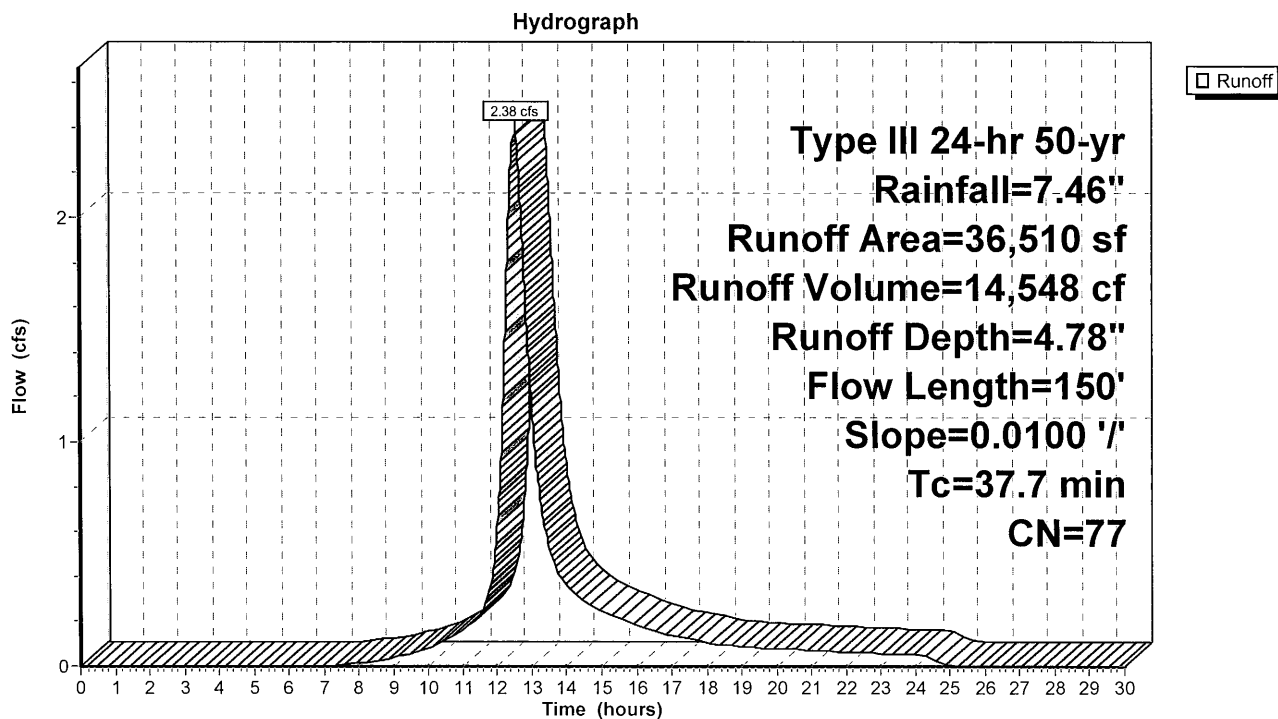
Runoff = 2.38 cfs @ 12.52 hrs, Volume= 14,548 cf, Depth= 4.78"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

Type III 24-hr 50-yr Rainfall=7.46"

	Area (sf)	CN	Description
*	1,795	98	Driveway
*	1,045	98	Rear Hardscape
	10,270	74	>75% Grass cover, Good, HSG C
	16,770	77	Woods, Good, HSG D
	6,630	70	Woods, Good, HSG C
	36,510	77	Weighted Average
	33,670		Pervious Area
	2,840		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
37.7	150	0.0100	0.07		Sheet Flow, AB
Woods: Light underbrush n= 0.400 P2= 3.45"					

**Subcatchment E1a: Undetained Area**

## Existing Conditions - 19 Holly

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Type III 24-hr 50-yr Rainfall=7.46"

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### Summary for Subcatchment E1b: Detained Area

Runoff = 0.61 cfs @ 12.07 hrs, Volume= 2,094 cf, Depth= 7.22"

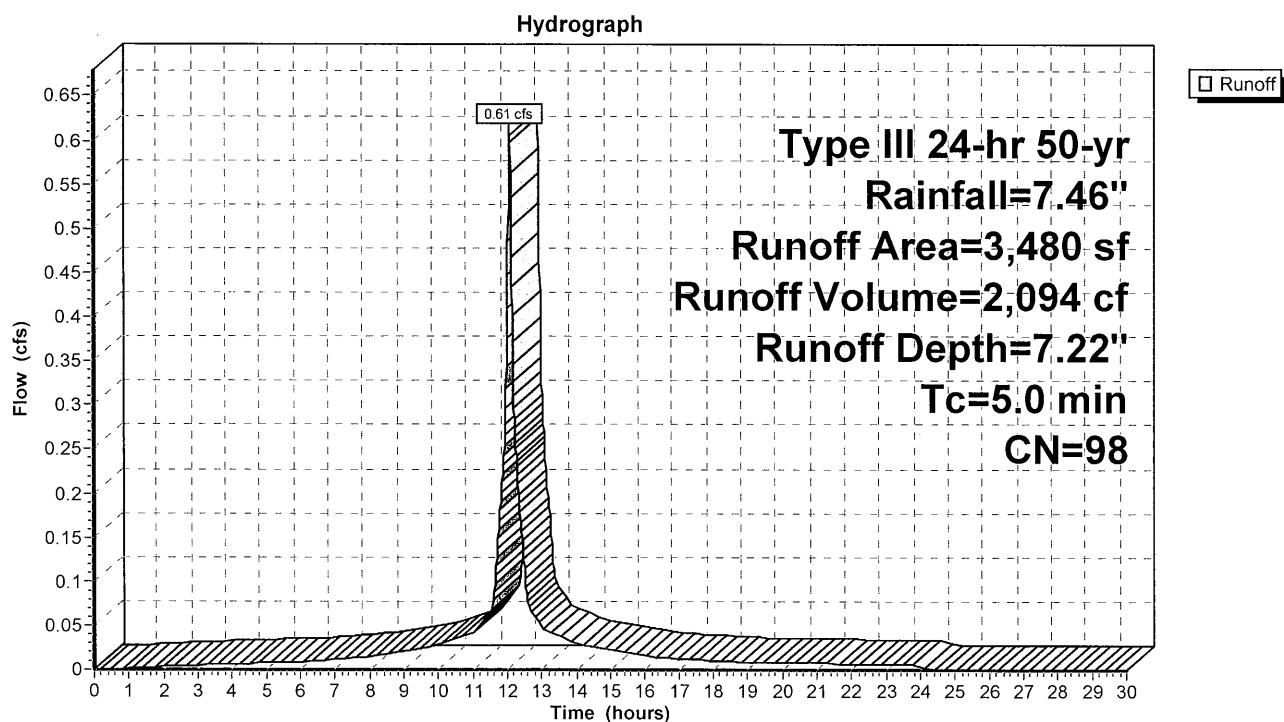
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

Type III 24-hr 50-yr Rainfall=7.46"

Area (sf)	CN	Description
* 3,480	98	Residence
3,480		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					Direct Entry, Minimum

### Subcatchment E1b: Detained Area



## Existing Conditions - 19 Holly

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Type III 24-hr 50-yr Rainfall=7.46"

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### Summary for Pond DET: Detention System

Inflow Area = 3,480 sf, 100.00% Impervious, Inflow Depth = 7.22" for 50-yr event  
Inflow = 0.61 cfs @ 12.07 hrs, Volume= 2,094 cf  
Outflow = 0.10 cfs @ 12.53 hrs, Volume= 1,762 cf, Atten= 84%, Lag= 27.4 min  
Primary = 0.10 cfs @ 12.53 hrs, Volume= 1,762 cf

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs  
Peak Elev= 98.36' @ 12.53 hrs Surf.Area= 1,200 sf Storage= 1,091 cf

Plug-Flow detention time= 225.8 min calculated for 1,761 cf (84% of inflow)  
Center-of-Mass det. time= 158.1 min ( 899.3 - 741.2 )

Volume	Invert	Avail.Storage	Storage Description
#1	96.80'	595 cf	6.00'W x 50.00'L x 2.20'H Gravel Bed x 4 2,640 cf Overall - 1,152 cf Embedded = 1,488 cf x 40.0% Voids
#2	97.30'	772 cf	48.0"W x 18.0"H x 48.00'L Galley 4x8x1.5 x 4 Inside #1
		1,367 cf	Total Available Storage

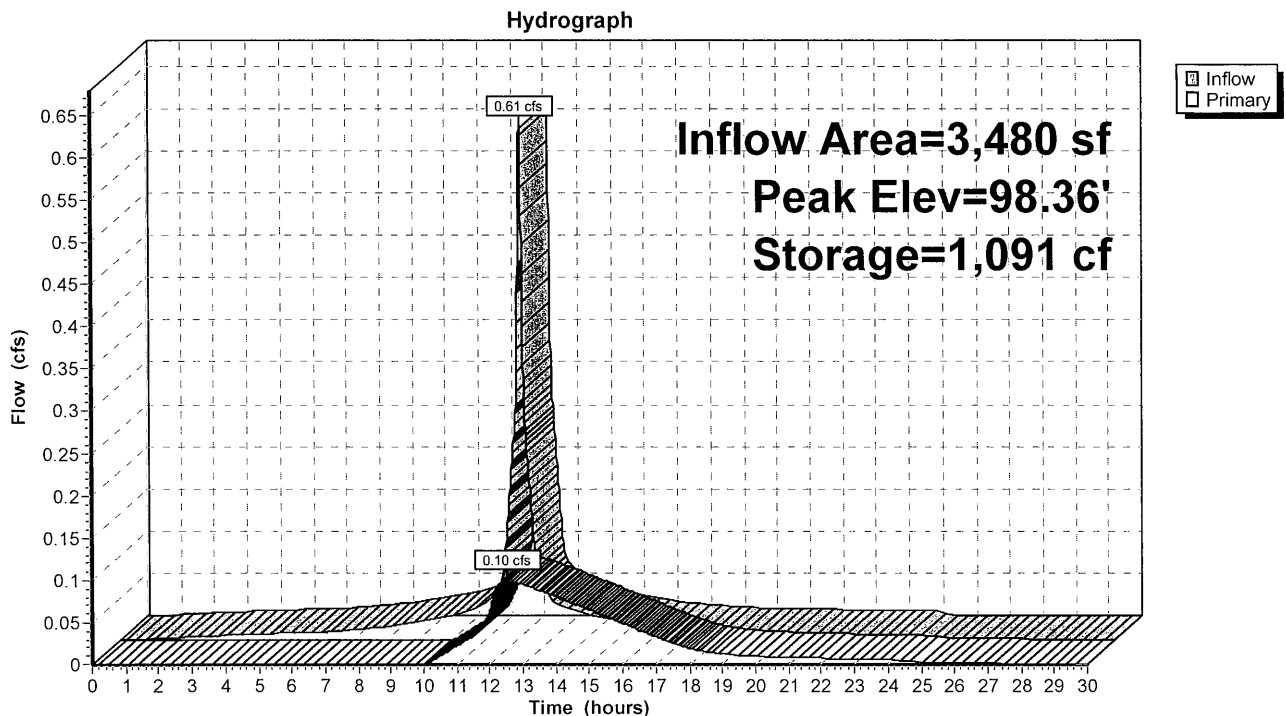
Device	Routing	Invert	Outlet Devices
#1	Primary	97.40'	2.0" Vert. Low Flow Orifice C= 0.600
#2	Primary	98.80'	6.0" Horiz. High Level Overflow Pipe Limited to weir flow C= 0.600

Primary OutFlow Max=0.10 cfs @ 12.53 hrs HW=98.36' (Free Discharge)

1=Low Flow Orifice (Orifice Controls 0.10 cfs @ 4.51 fps)

2=High Level Overflow Pipe ( Controls 0.00 cfs)

### Pond DET: Detention System



## Existing Conditions - 19 Holly

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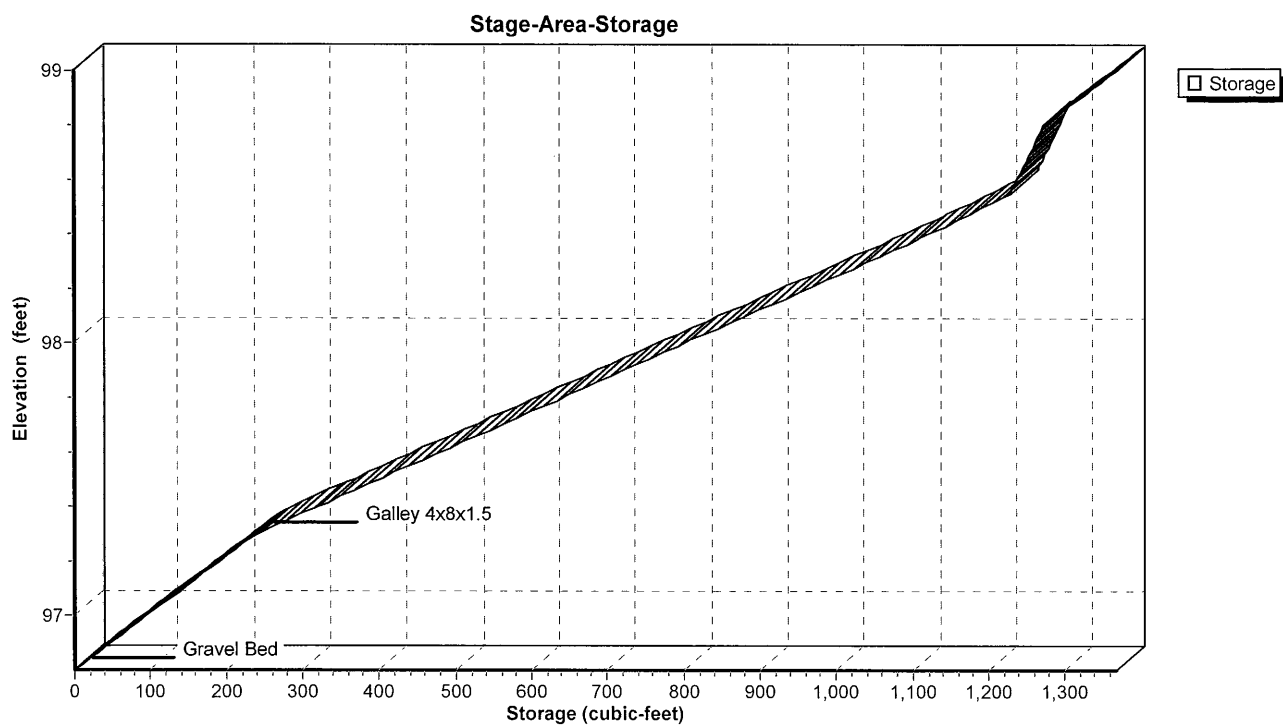
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Type III 24-hr 50-yr Rainfall=7.46"

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### Pond DET: Detention System



## Existing Conditions - 19 Holly

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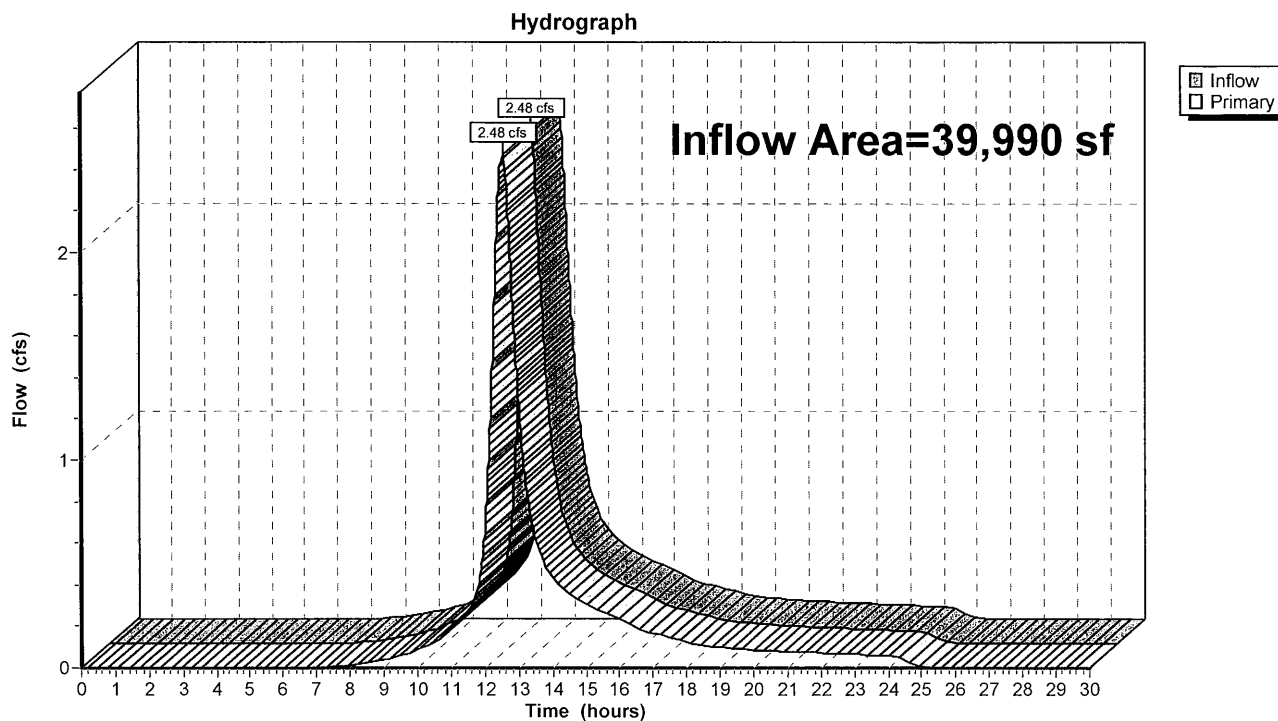
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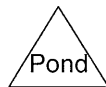
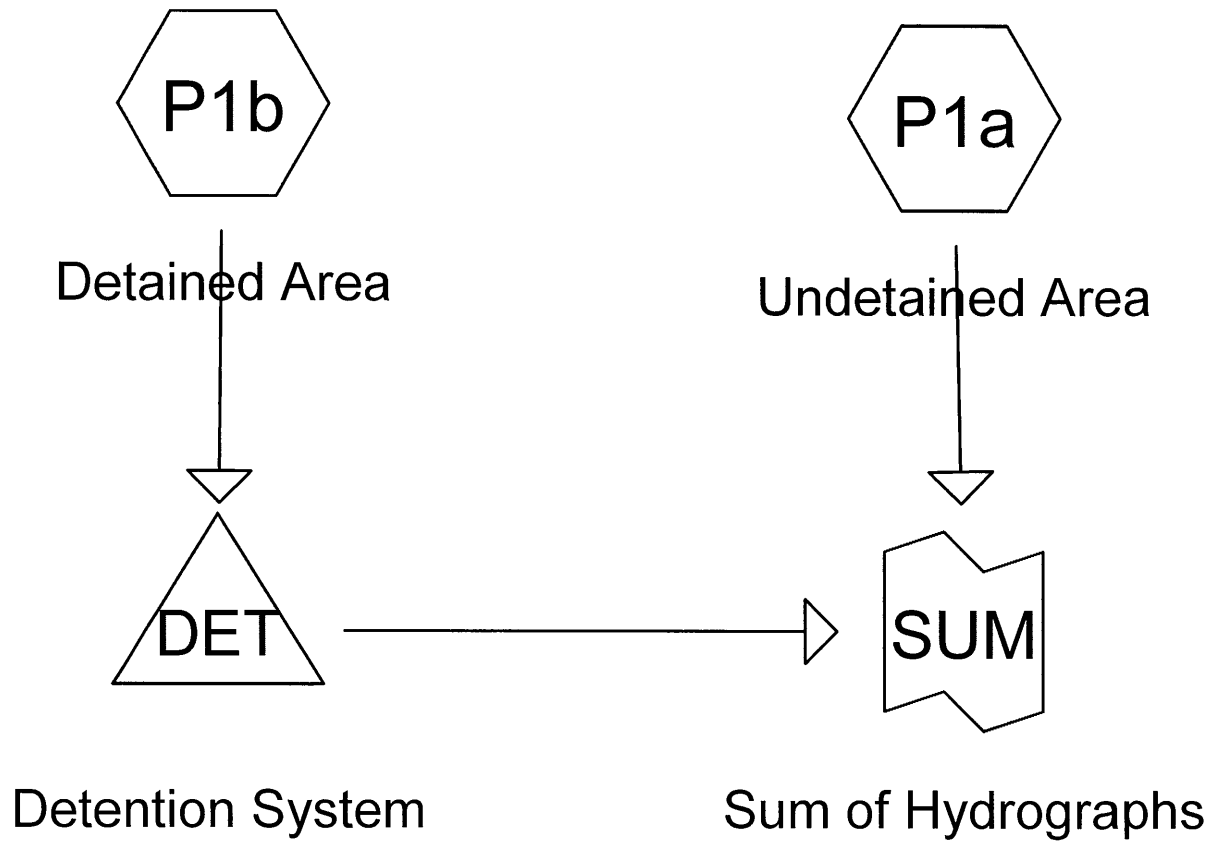
### Summary for Link SUM: Sum of Hydrographs

Inflow Area = 39,990 sf, 15.80% Impervious, Inflow Depth > 4.89" for 50-yr event  
Inflow = 2.48 cfs @ 12.52 hrs, Volume= 16,309 cf  
Primary = 2.48 cfs @ 12.52 hrs, Volume= 16,309 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

### Link SUM: Sum of Hydrographs





## Proposed Conditions - 19 Holly

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### Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
6,630	70	Woods, Good, HSG C (P1a)
8,534	74	>75% Grass cover, Good, HSG C (P1a,P1b)
16,770	77	Woods, Good, HSG D (P1a)
1,795	98	Driveway (P1a)
512	98	New Pool (P1a,P1b)
1,224	98	New Pool Hardscape (P1a,P1b)
1,045	98	Rear Hardscape (P1a,P1b)
3,480	98	Residence (P1b)
<b>39,990</b>		<b>TOTAL AREA</b>



**Proposed Conditions - 19 Holly***Type III 24-hr 50-yr Rainfall=7.46"*

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Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 points

Runoff by SCS TR-20 method, UH=SCS

Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment P1a: Undetained Area**

Runoff Area=34,294 sf 8.69% Impervious Runoff Depth=4.78"

Flow Length=150' Slope=0.0100 '/' Tc=37.7 min CN=77 Runoff=2.24 cfs 13,665 cf

**Subcatchment P1b: Detained Area**

Runoff Area=5,696 sf 89.12% Impervious Runoff Depth=6.86"

Tc=5.0 min CN=95 Runoff=0.98 cfs 3,258 cf

**Pond DET: Detention System**

Peak Elev=98.92' Storage=1,544 cf Inflow=0.98 cfs 3,258 cf

Outflow=0.34 cfs 2,869 cf

**Link SUM: Sum of Hydrographs**

Inflow=2.47 cfs 16,534 cf

Primary=2.47 cfs 16,534 cf

**Total Runoff Area = 39,990 sf Runoff Volume = 16,922 cf Average Runoff Depth = 5.08"****79.85% Pervious = 31,934 sf 20.15% Impervious = 8,056 sf**

**Proposed Conditions - 19 Holly**

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**Summary for Subcatchment P1a: Undetained Area**

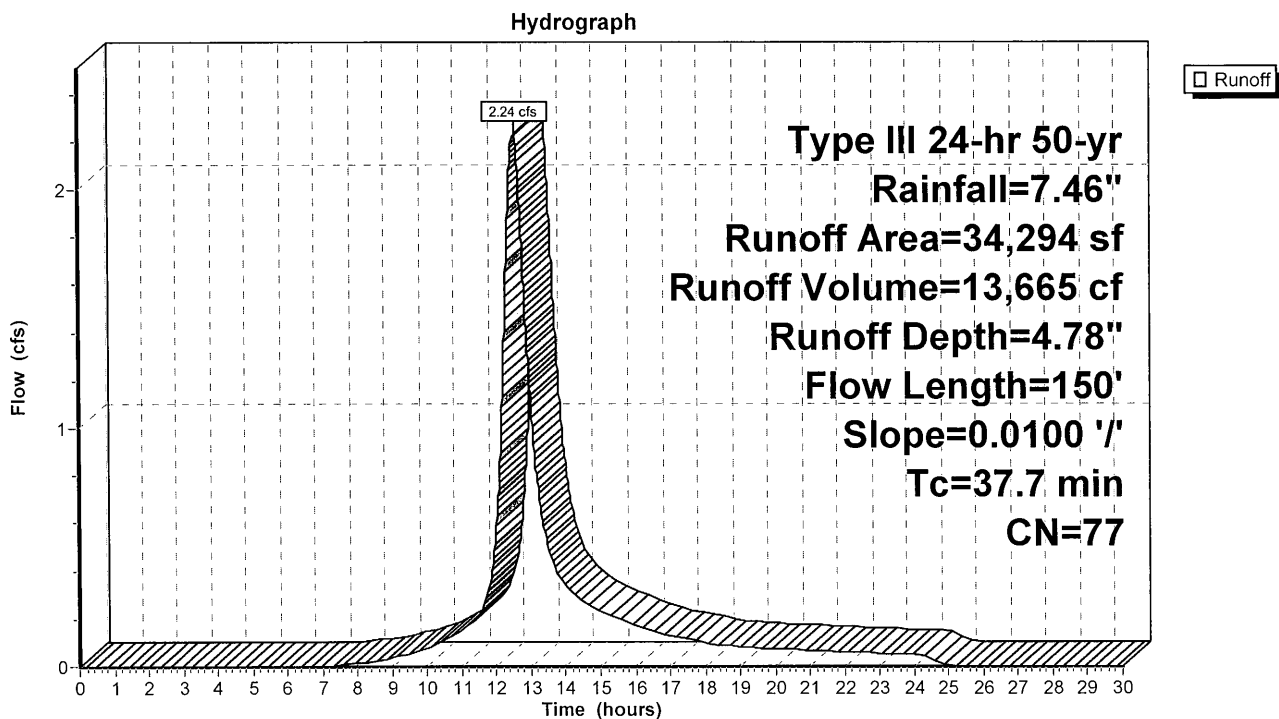
Runoff = 2.24 cfs @ 12.52 hrs, Volume= 13,665 cf, Depth= 4.78"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

Type III 24-hr 50-yr Rainfall=7.46"

	Area (sf)	CN	Description
*	1,795	98	Driveway
*	275	98	Rear Hardscape
*	256	98	New Pool
*	654	98	New Pool Hardscape
	7,914	74	>75% Grass cover, Good, HSG C
	16,770	77	Woods, Good, HSG D
	6,630	70	Woods, Good, HSG C
	34,294	77	Weighted Average
	31,314		Pervious Area
	2,980		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
37.7	150	0.0100	0.07		Sheet Flow, AB
					Woods: Light underbrush n= 0.400 P2= 3.45"

**Subcatchment P1a: Undetained Area**

**Proposed Conditions - 19 Holly**

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**Summary for Subcatchment P1b: Detained Area**

Runoff = 0.98 cfs @ 12.07 hrs, Volume= 3,258 cf, Depth= 6.86"

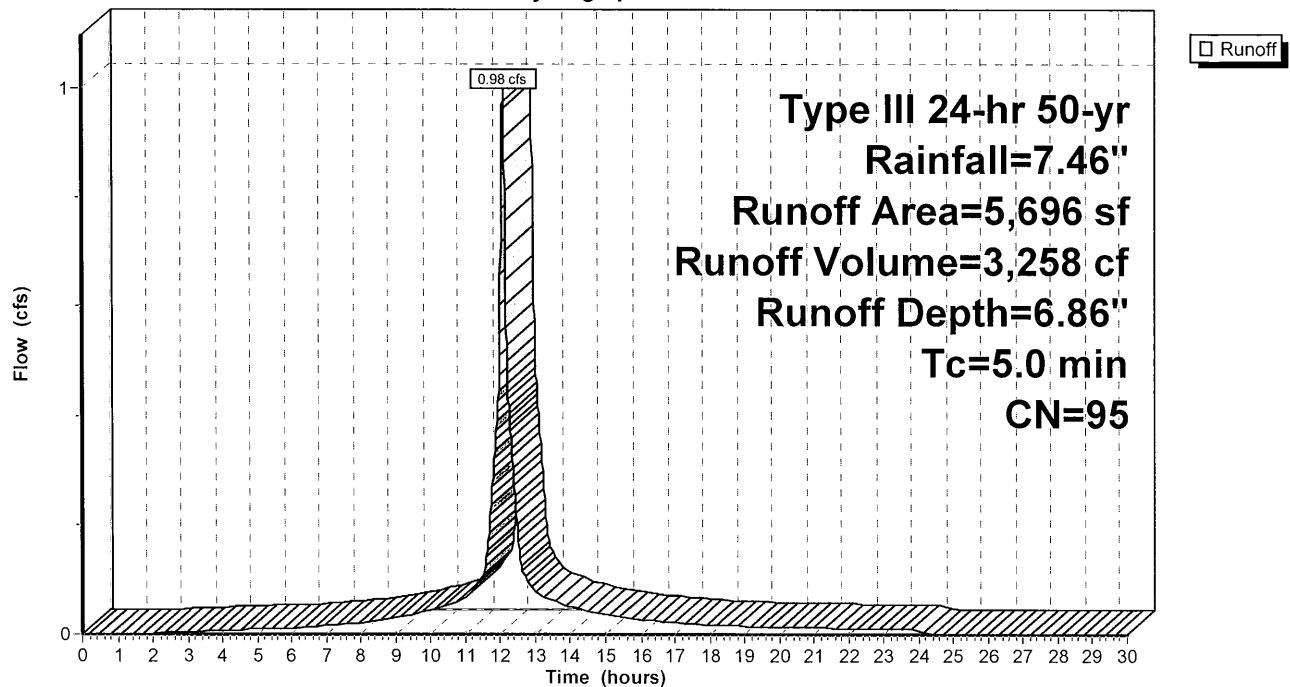
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs  
Type III 24-hr 50-yr Rainfall=7.46"

	Area (sf)	CN	Description
*	3,480	98	Residence
*	770	98	Rear Hardscape
*	256	98	New Pool
*	570	98	New Pool Hardscape
	620	74	>75% Grass cover, Good, HSG C
	5,696	95	Weighted Average
	620		Pervious Area
	5,076		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					Direct Entry, Minimum

**Subcatchment P1b: Detained Area**

Hydrograph



## Proposed Conditions - 19 Holly

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Type III 24-hr 50-yr Rainfall=7.46"

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### Summary for Pond DET: Detention System

Inflow Area = 5,696 sf, 89.12% Impervious, Inflow Depth = 6.86" for 50-yr event  
Inflow = 0.98 cfs @ 12.07 hrs, Volume= 3,258 cf  
Outflow = 0.34 cfs @ 12.31 hrs, Volume= 2,869 cf, Atten= 65%, Lag= 14.6 min  
Primary = 0.34 cfs @ 12.31 hrs, Volume= 2,869 cf

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs  
Peak Elev= 98.92' @ 12.31 hrs Surf.Area= 1,392 sf Storage= 1,544 cf

Plug-Flow detention time= 210.9 min calculated for 2,869 cf (88% of inflow)  
Center-of-Mass det. time= 155.2 min ( 912.9 - 757.6 )

Volume	Invert	Avail.Storage	Storage Description
#1	96.80'	687 cf	6.00'W x 58.00'L x 2.20'H Gravel Bed x 4 3,062 cf Overall - 1,344 cf Embedded = 1,718 cf x 40.0% Voids
#2	97.30'	901 cf	48.0"W x 18.0"H x 56.00'L Galley 4x8x1.5 x 4 Inside #1
		1,588 cf	Total Available Storage

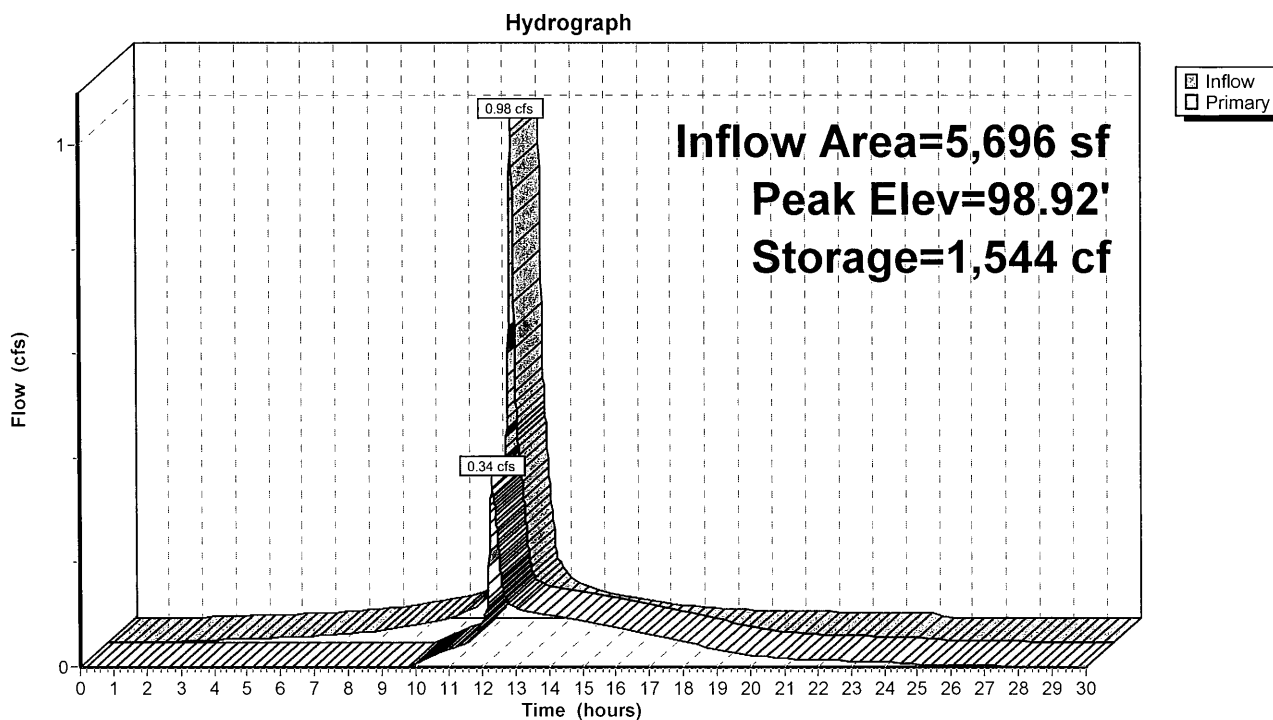
Device	Routing	Invert	Outlet Devices
#1	Primary	97.40'	2.0" Vert. Low Flow Orifice C= 0.600
#2	Primary	98.80'	6.0" Horiz. High Level Overflow Pipe Limited to weir flow C= 0.600

Primary OutFlow Max=0.34 cfs @ 12.31 hrs HW=98.92' (Free Discharge)

1=Low Flow Orifice (Orifice Controls 0.13 cfs @ 5.77 fps)

2=High Level Overflow Pipe (Weir Controls 0.22 cfs @ 1.14 fps)

### Pond DET: Detention System



## Proposed Conditions - 19 Holly

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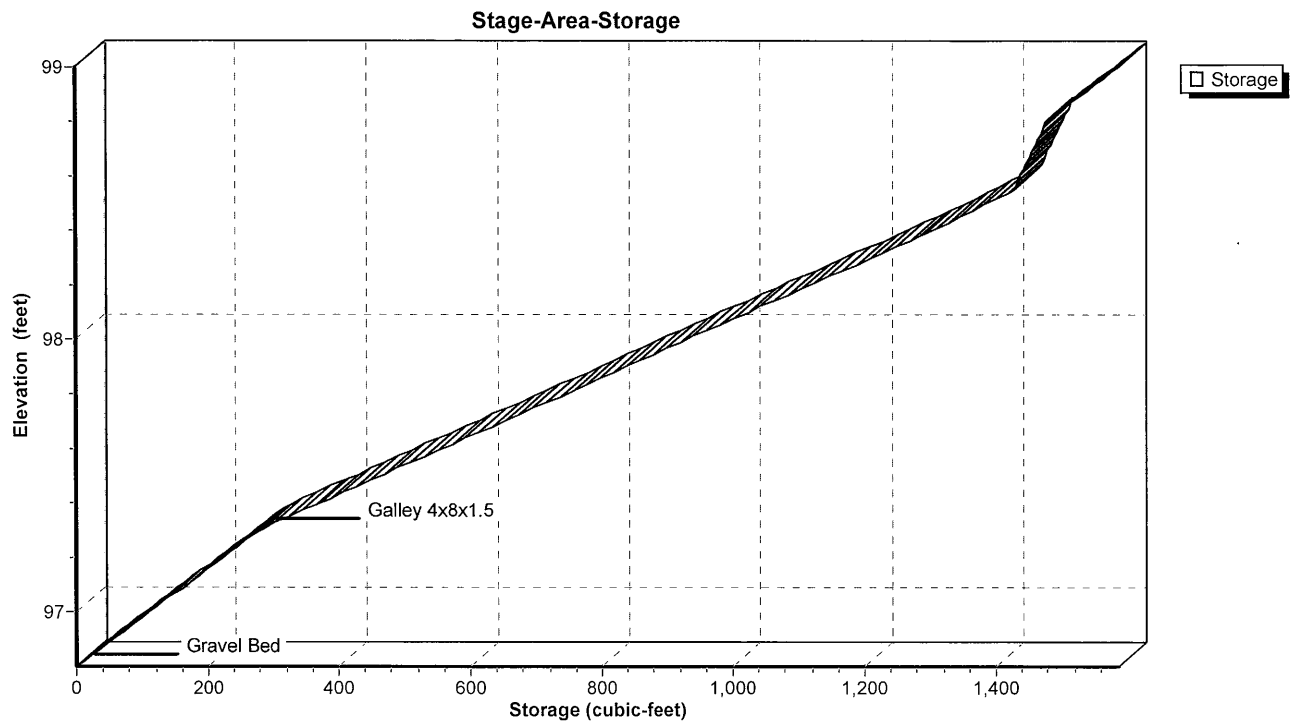
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### Pond DET: Detention System



## Proposed Conditions - 19 Holly

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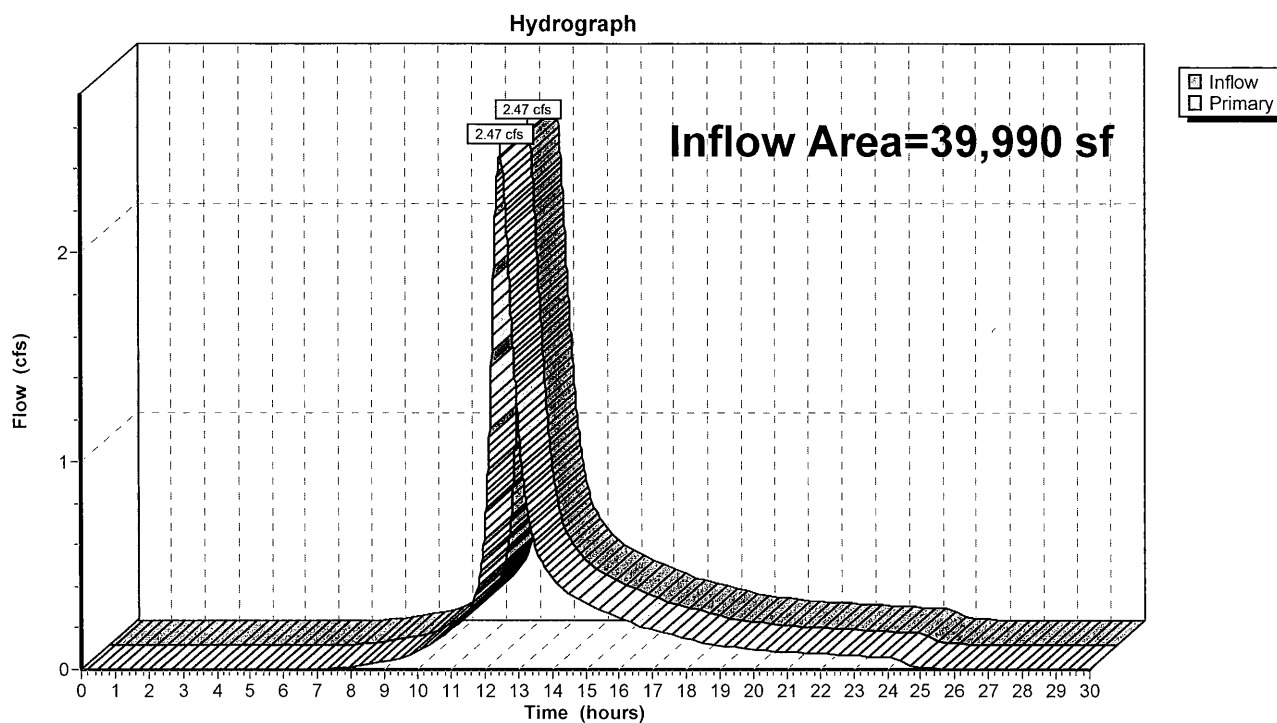
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### Summary for Link SUM: Sum of Hydrographs

Inflow Area = 39,990 sf, 20.15% Impervious, Inflow Depth > 4.96" for 50-yr event  
Inflow = 2.47 cfs @ 12.48 hrs, Volume= 16,534 cf  
Primary = 2.47 cfs @ 12.48 hrs, Volume= 16,534 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

### Link SUM: Sum of Hydrographs



**APPENDIX B:**  
**STORMWATER FACILITIES MAINTENANCE PLAN**

# **Stormwater Facilities Maintenance Plan**

**19 Holly Lane, Darien, CT**

**Map 09, Lot 143**

## **Scope:**

The purpose of the Stormwater Facilities Maintenance Plan is to insure that the proposed stormwater components installed for the 19 Holly Lane are maintained in operational condition throughout the life of the proposed development. The service procedures associated with this plan shall be performed as required by the parties legally responsible for their maintenance.

## **Description of Stormwater Facilities:**

The proposed stormwater facilities are designed to collect, convey, detain and treat the runoff from the site in order to minimize adverse impacts to the adjoining lagoon. A description of the stormwater facilities are as follows:

1. **Roof Leaders/Gutters:** Roof leaders (also known as downspouts) from the house will convey roof runoff collected by the roof gutters on the proposed residence to the underground detention chambers.
2. **Yard Drains:** Yard drains will collect runoff from the hardscape and surrounding lawn and convey it to the underground detention chambers. They are equipped with a sump designed to capture sediment and debris from the runoff.
3. **Slot Drains:** Slot drains will collect runoff from the hardscape and pool and convey it to the underground detention chambers.
4. **Underground Detention Chambers:** The underground detention system consists of a series of concrete chambers which provide water quality storage volume for the stormwater runoff. Stormwater in the underground detention system is designed to infiltrate into the underlying soils. The detention chambers are designed to overflow to a high level over flow pipe during extreme storm events.

## **Recommended Frequency of Service:**

All of the stormwater components installed for this property should be checked periodically and kept in full working order. Ultimately the frequency of inspection and service cleaning depends on the amount of runoff, pollutant loading and interference from debris (leaves, vegetation, trash, etc.); however it is recommended that each facility be inspected and cleaned a minimum of two times a year. The guidelines for the timing of service include early spring after the winter season and late fall after the leaves have fallen from the trees.

## **Service Procedures:**

Service can be performed by the homeowner, landscape contractor or handyman since no specialized equipment is required. Specific service procedures for the stormwater facilities are as follows:

1. **Roof Leaders/Gutters:** Roof gutters shall be inspected twice a year during the spring and fall service inspections to ensure that roof leaders are kept free of leaves and debris that could clog the detention chambers. At a minimum, leaves should be cleaned from the gutters during the fall service inspection.
2. **Yard Drains:** Yard drains shall be inspected and cleaned twice a year during the spring and fall service inspections. The cleaning shall include both removal of sediment from the sumps and removal of any trash and/or debris from the grate. The 2" diameter low flow outlet to the detention should also be cleared of debris.
3. **Slot Drains:** Slot drains shall be inspected and cleaned twice a year during the spring and fall service inspections. The cleaning shall include both removal of any trash and/or debris from the grate.
4. **Underground Detention Chambers:** Functionality of the underground detention chambers ultimately depends on keeping sediment and debris out of the chambers. This is accomplished through proper maintenance of the roof leaders, gutters and yard drains. These components should be maintained as described above, but more frequent maintenance may be required if excessive accumulation of debris is observed.